

A NEW SPECIES OF *OTATEA* (POACEAE: BAMBUSOIDEAE: BAMBUSEAE) FROM QUERÉTARO, MEXICO

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ABSTRACT

Based on recent systematic studies of the genus *Otatea*, that included an extensive taxonomic investigation of herbaria specimens, and recent fieldwork in the Mexican state of Querétaro, a new *Otatea* species, *O. ramirezii*, is here described and illustrated. The new species is endemic to the Sierra Gorda in Querétaro, Mexico. It is compared with *Otatea acuminata*, *O. carrilloi* and *O. glauca*, from which it can be separated by the presence of only one (rarely two) branches per node, erect culm leaf blades, and the absence of oral setae both in culm and foliage leaves.

Key words: endemic Guaduinae, Mexico, *Otatea*, Poaceae, Querétaro, Sierra Gorda, woody bamboo.

RESUMEN

Basado en un estudio previo sobre sistemática del género *Otatea*, el cual incluye una amplia revisión de ejemplares de herbario y también en recientes colecciones botánicas realizadas en el estado de Querétaro, se describe e ilustra una nueva especie de *Otatea*, *O. ramirezii*. El nuevo taxon es endémico de la Sierra Gorda en Querétaro. Se compara con *Otatea acuminata*, *O. carrilloi* y *O. glauca*, de las cuales se diferencia por desarrollar una sola rama por nudo (rara vez dos), láminas de las hoja caulinar erectas y ausencia de setas orales en hojas caulinares y hojas foliares.

Palabras clave: bambú leñoso, Guaduinae endémica, México, *Otatea*, Poaceae, Querétaro, Sierra Gorda.

Otatea (McClure & E. W. Sm) C. Calderón & Soderstr., an American woody bamboo genus of the subtribe Guaduinae, comprises seven species with a geographical distributions restricted to Mexico, El Salvador, Honduras and Colombia and with six species endemic to Mexico (Guzmán et al., 1984; Judziewicz et al., 1999; Londoño and Clark, 1998; Ruiz-Sanchez et al., 2008; Ruiz-Sanchez and Sosa, 2010; Ruiz-Sanchez et al., 2011a).

Previous phylogenetic studies based on morphological and molecular data support the monophyly of *Otatea* and its sister relationship with the Mesoamerican bamboo genus *Olmea* (Ruiz-Sanchez et al., 2008; Ruiz-Sanchez et al., 2011b). Two morphological synapomorphies have been identified for *Otatea*: 1) branch complements with three subequal and ascending branches and 2) spikelets with pubescent lemmas (Ruiz-Sanchez et al., 2008). However, two recently described species of *Otatea* (*O. reynosoana* and *O. transvolcanica*) mostly have only one or two branches per node. Sometimes three branches occur with the second and third branches smaller in diameter than the central or primary branch (Ruiz-Sanchez et al., 2011a). Like most bamboos, *Otatea* is monocarpic with mass flowering in cycles that, according to herbarium records, occur in 8-30 year cycles (Guzmán et al., 1984; Judziewicz et al., 1999; Ruiz-Sanchez et al., 2011a); populations usually flower for two or three years consecutively and die (Ruiz-Sanchez et al., 2011a). Due to the long intervals between flowering times, a few species have been described based only on vegetative features, including *O. carrilloi* and *O. transvolcanica* (Ruiz-Sanchez et al., 2011a).

A new *Otatea* species from Sierra Gorda of Querétaro with only one (rarely two) branches per node, erect culm leaf blades, and the absence of oral setae both in culm and foliage leaves is described and illustrated in this paper. Also, a key to the eight species of *Otatea* is presented.

Key to the species of *Otatea*

- 1 Foliage leaves of the primary branches with blades 0.3-1.2 cm wide, abaxially green 2

- 1 Foliage leaves of the primary branches with blades 0.6-6 cm wide, abaxially glaucous 4
- 2 Culm leaf blades erect; foliage oral setae absent 7
- 2 Culm leaf blades reflexed; foliage oral setae present 3
 - 3 Foliage leaf blades 18-26 cm long; foliage oral setae 6.6-24.1 mm long, fimbriae 8.4-21.8 mm long, straight; culm leaf oral setae 15-30.6 mm long, fimbriae 10.3-19.3 mm long, straight
..... *O. carrilloi* Ruiz-Sanchez, Sosa & Mejía-Saulés
 - 3 Foliage leaf blades 10-16 cm long; foliage oral setae 2.5-6 mm long, fimbriae 1-4 mm long, curly; culm leaf oral setae 2.5-11.5 mm long, fimbriae 1.5-4 mm long, curly *O. glauca* L. G. Clark & G. Cortés
 - 4 Culm leaf blades reflexed 5
 - 4 Culm leaf blades erect 6
 - 5 Foliage oral setae 4.3-6 mm long, free; lobes of the outer ligule absent; culm leaf sheaths 9.5-12.5 cm long, non-overlapping; culm leaf blades 1.6-7.5 cm long
..... *O. ximenae* Ruiz-Sanchez & L. G. Clark
 - 5 Foliage oral setae 13-21.5 mm long, connate for the basal one-third or more; lobes of the outer ligule present 3-8 mm long; culm leaf sheaths 24-29.5 cm long, overlapping; culm leaf blades 9-20 cm long *O. transvolcanica* Ruiz-Sanchez & L. G. Clark
 - 6 Oral setae of culm and foliage leaves papraceous, white; branches per node usually one or two; foliage leaf blades abaxially with a patch of white cilia at the base on both sides of the midrib *O. reynosoana* Ruiz-Sanchez & L. G. Clark
 - 6 Oral setae of culm and foliage leaves coriaceous, brown or purple; branches per node three, subequal; foliage leaf blades abaxially with a patch of yellow to brown cilia at the base on one side of the midrib *O. fimbriata* Soderstr.
 - 7 Development of three subequal and ascending branches per node; fimbriae on culm leaves 4-7 mm long; some populations develop oral setae on culm leaves
..... *O. acuminata* (Munro) C. Calderón & Soderstr.
 - 7 Development of one main ascending branch per node, if two branches present then the lateral narrower than the main or central; fimbriae on culm leaves 1-3 mm long; lack oral setae on culm leaves *O. ramirezii* Ruiz-Sanchez

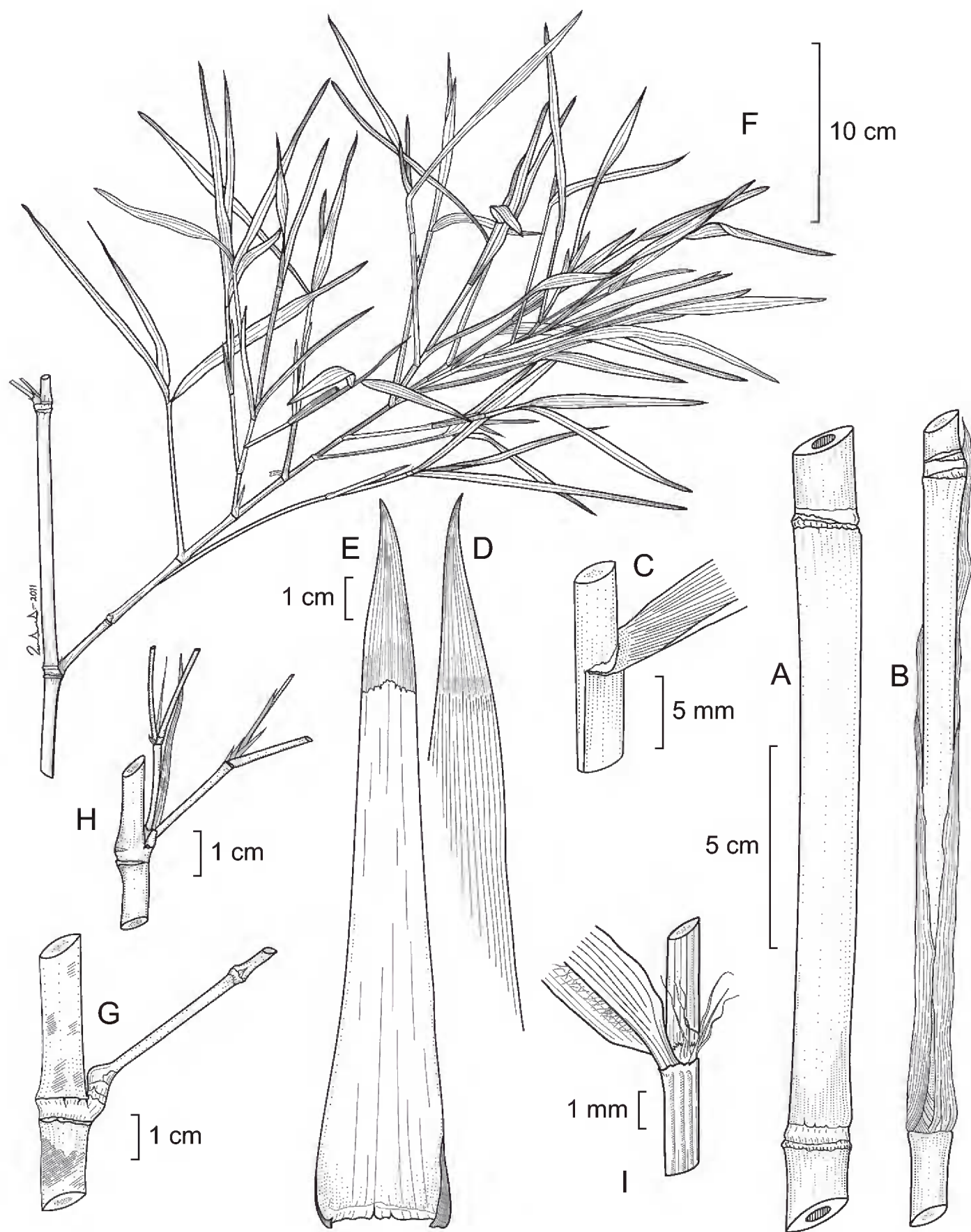


Fig. 1. *Otatea ramirezii* Ruiz-Sanchez. A. culm with upper and bottom nodes; B. culm with culm leaf sheath; C. ligular area of culm leaf sheath from a new shoot; D. culm leaf, abaxial view; E. culm leaf, adaxial view; F. branch complement with foliage leaf complement; G. branch complement showing one branch. H. branch complement showing two branches; I. ligular area of foliage leaf with fimbriae and patch of white cilia at the base extending along one side of the midrib (based on Ruiz-Sánchez & A. de Nova 304). Drawing by David Jimeno Sevilla.

Otatea ramirezii Ruiz-Sanchez sp. nov. Fig. 1.

Culmi 2 -3 m alti, 0.8-1-7 cm diam, erecti. Folia culmorum 12-17 cm longa; vaginae 10-12 cm longae, laminae 1.8-4.5 cm longae, erectae, triangulares, abaxialiter glabrescentes. Vaginarum caulinarium setae orales desunt. Ramus unus raro duo per nodum. Secundarius et tertiarius nodus unum ramum ferens. Primarius ramus 33-48 cm longus. Folia ramorum 3-7 per complementum, vaginae glabrae; laminae 6.5-12.5 cm longae, 0.4-1.2 cm latae, lineares vel lineari-lanceolatae. ad 30 mm longae, foliorum frondosarum setae orales desunt.

Rhizomes with necks 5-15 cm long. Culms 2-3 m tall, 0.8-1.7 cm in basal diameter, erect; internodes 12-16 cm long, terete, glabrous, green when young and brown-yellow when old, hollow, the walls 3-5 mm thick, the lacuna occupying <50% of the total diameter. Culm leaves 12-17 cm long, non-overlapping, deciduous; sheaths 10-12 cm long, 3.5-5 cm wide at the base, the leaf blades 1.8-4.5 cm long, triangular, abaxially and adaxially glabrous, the margins ciliate when young, glabrous when old; inner ligule a coriaceous rim 0.5-1 mm long, irregular, ciliate; oral setae absent; fimbriae at the apex of the sheath on both sides of the blade, 1-3 mm long, ca. 0.05 mm wide, terete, free, curly; blades 1.8-4.5 cm long, triangular, erect, persistent, shorter than the sheaths, glabrous on both sides, margin glabrous, apex attenuate-subulate. Branching intravaginal; one main branch per node, if two then the central 3-4 times wider than the lateral, sometimes both branches are subequal and these are diverging from each other and rebranching, 33-48 cm long, diverging from the main culm at 45-60°, with only one branch in the second and third order of branching; supranodal ridge pronounced; nodal line horizontal. Foliage leaves 3-5(-7) per complement, when young 5-7 per complement; sheaths glabrous, rounded on the back; oral setae absent; fimbriate at shoulders sheath summit, the fimbriae 1-2 mm long, ca. 0.05 mm in diameter, terete, free, curly; outer ligule an irregular glabrous rim up to 0.1 mm long; inner ligule 0.3-0.5 mm long, truncate, ciliate; pseudopetioles ca. 1 mm long, brownish, pulvinate at the base; blades (6.5)8-11(12.5) cm long, 0.4-0.8(1.2) cm wide, linear to linear-lanceolate, green adaxially and glabrous abaxially, with a patch of white cilia at the base extending along one side of the midrib for 2-3 mm, the base attenuate, the apex attenuate-subulate, the margins weakly serrulate. Synflorescences not seen.

TYPE: MÉXICO, **Querétaro**, 500 m antes de llegar a San Juan Tetla desde El Apartadero, municipio de San Joaquín, 20°58'40.8" N, 99°29'47" W, bosque tropical

caducifolio, suelos calizos, alt. 1223 m, 10 Jul. 2010, *E. Ruiz-Sánchez & A. de Nova* 304 (holotype: IBUG; isotypes: IEB, MEXU, XAL).

Habitat and distribution. Apparently, *Otatea ramirezii* represents a narrow endemic of the southernmost part of the Sierra Gorda in Querétaro, where it forms large populations inhabiting tropical dry forests and their ecotone with oak forests on hillsides composed of calcareous rocks at elevations between 1200 and 1600 m.

On the basis of morphology, *Otatea ramirezii* morphologically resembles *O. acuminata*, *O. carrilloi* and *O. glauca*. All four are similar in habit with culms that are erect or arching apically and their foliage leaves that are similar in size and form. However, the latter three species develop three subequal ascending branches per node, whereas *O. ramirezii* develops mostly only one branch per node (Table 1). In some cases, two branches per node are present, but the second one is noticeably narrower than the main branch and it develops later. Additionally, *O. ramirezii* lacks oral setae in culm and foliage leaves and has erect culm leaf blades. *Otatea carrilloi* and *O. glauca* have oral setae in both culm and foliage leaves and their culm leaf blades are reflexed. Alternatively most of the populations in *Otatea acuminata* have oral setae in the culm leaves but they are absent in the foliage leaves and its culm leaf blades are erect (Table 1). *Otatea carrilloi* and *O. glauca* are known from a single population each. Both are endemic to Chiapas. *Otatea acuminata* has the widest geographical distribution in Mexico, including two populations near *O. ramirezii*, one in Querétaro only 22 km to northwest of *O. ramirezii* on the other side of the Sierra Gorda and another one 53 km to the southeast of *O. ramirezii* in the Barranca of Tolantongo, Hidalgo. The populations of *Otatea acuminata* in Querétaro and Hidalgo grow in calcareous soils and plants from both of these populations develop three subequal ascending branches per node.

Etymology. The specific epithet honors the memory of Raymundo Ramírez Delgadillo (1968-2011), professor from the Universidad de Guadalajara, Mexico, whom I most owe my interest in systematic botany.

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Table 1. Comparisons of morphological characters among *Otatea acuminata*, *O. glauca*, *O. carrilloi* and *O. ramirezii*.

Character/taxa	<i>O. acuminata</i>	<i>O. glauca</i>	<i>O. carrilloi</i>	<i>O. ramirezii</i>
Culm habit	erect and arching apically	arching apically	arching apically	erect
Culm size				
length (m)	2-10	8	3-5	2-3
diameter (cm)	1-5	3	1-3.5	0.8-1.7
Internode size				
length (cm)	9.5-24	27-30	11-19	12-16
wall thickness (mm)	2-4	1.5-2	3.5-6.9	3-5
Culm leaves				
sheath length (cm)	5-30	14-22	19-28	10-12
relative position	overlapping or not	non-overlapping	overlapping	non-overlapping
duration	deciduous or persistent	deciduous	deciduous	deciduous
Culm leaf blades				
length (cm)	6-18	3.5-8.2	10-31	1.8-4.5
position	erect	reflexed	reflexed	erect
basal margin indument	ciliate, glabrous or hirsute	glabrous	fimbriate	glabrous
Oral setae on culm leaves				
length (mm)	10-15 when present	2.5-11.5	15-30.6	absent
color in living specimens	brown	bright green	green-yellow	-
Fimbriae on culm leaves	present	present	present	present
position	at shoulders	at shoulders	at blade base and sheath summit	at shoulders
posture	curly	curly	straight	curly
length (mm)	4-7	1.5-4	10.3-19.3	1-3
Branches per node	3	3	3	1 (rarely 2)

Table 1. Continuation

Character/taxa	<i>O. acuminata</i>	<i>O. glauca</i>	<i>O. carrilloi</i>	<i>O. ramirezii</i>
Foliage leaf blade				
length (cm)	4-22	10-16	18-26	6.5-12.5
width (cm)	0.3-1.2	0.3-1	0.6-0.9	0.4-1.2
Oral setae on foliage leaves	absent	present	present	absent
length (mm)	-	2.5-6	6.6-24	-
connate at base	-	no	no	-
color when live	-	green	green-yellow	-
Fimbriae on foliage leaves				
length (mm)	1-3	1-4	8.5-22	1-2
posture	curly	curly	straight	curly

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LITERATURE CITED

- Guzmán, R., M. C. Anaya & M. Santana. 1984. El género *Otatea* (Bambusoideae), en México y Centroamérica. Bol. Inst. Bot. Univ. Guadalajara 5: 2-20.
- Judziewicz, E. J., L. G. Clark, X. Londoño & M. J. Stern. 1999. American bamboos. Smithsonian Institution Press. Washington D.C., USA. 392 pp.
- Londoño, X. & L. G. Clark. 1998. Eight new taxa and two new reports of Bambuseae (Poaceae: Bambuseae) from Colombia. Novon 8: 408-428.
- Ruiz-Sanchez, E. & V. Sosa. 2010. Delimiting species boundaries within the Neotropical bamboo *Otatea* (Poaceae: Bambusoideae) using molecular, morphological and ecological data. Molec. Phylog. Evol. 54: 344-356.
- Ruiz-Sanchez, E., V. Sosa & M. T. Mejía-Saulés. 2008. Phylogenetics of *Otatea* inferred from morphology and chloroplast DNA sequence data and recircumscription of Guaduinae (Poaceae: Bambusoideae). Syst. Bot. 33: 277-283.

- Ruiz-Sanchez, E., V. Sosa, M. T. Mejía-Saulés, X. Londoño & L. G. Clark. 2011a. A taxonomic revision of *Otatea* (Poaceae: Bambusoideae: Bambuseae) including four new species. *Syst. Bot.* 36: 314-336.
- Ruiz-Sanchez, E., V. Sosa & M. T. Mejía-Saulés. 2011b. Molecular phylogenetics of the Mesoamerican bamboo *Olmea* (Poaceae: Bambuseae): Implications for taxonomy. *Taxon* 60: 89-98.

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